A device for crushing or cutting material such as refuse is disclosed, comprising a rotatable, conical funnel segment for receiving objects to be crushed or shredded, and a cutting edge extending along an edge of the conical funnel segment for coaction with an adjacent cutting edge located in a surrounding housing. In a further embodiment, a conical funnel segment includes spiral ribs on its outer surface which coact with opposite-hand ribs in a surrounding conical funnel housing to crush objects caught therebetween and deliver the crushed objects to further means for cutting the crushed material to the desired size.

14 Claims, 21 Drawing Figures
MACHINE FOR CRUSHING AND CUTTING LARGE OBJECTS

BACKGROUND OF THE INVENTION

The invention concerns a crushing machine for large objects such as metallic, plastic, glass, textile or wooden articles of junk or the like.

The use of oppositely rotating cutting rollers in crushing machines is well known. Such crushing machines have, until now, been used solely for industrial purposes. The size of the insertion opening in the known types of machines bears a certain predetermined relationship to the dimensions of the cutting rollers. For this reason the known types of crushing machines must be relatively large when very large pieces of junk are to be broken down. This disadvantage is especially to be considered when a small and compact crushing machine is to be created such as will be needed in the future for crushing household rubbish.

SUMMARY OF THE INVENTION

The purpose of the invention is to provide a crushing machine of relatively simple construction having relatively small external dimensions, but which is capable of crushing large volumed objects.

This purpose is achieved according to the invention in that a rotatable funnel is provided having bearings at the rim and lower end and which can be driven by driving means at its upper outer rim, and which is internally largely free from parts which would reduce the cross-sectional area of the insertion opening, whereby cutting edges connected to the funnel coat with fixed cutting edges, thus cutting and crushing the inserted rubbish.

A cutting machine of this type has the great advantage that it can be made quite small, despite the large insertion opening; thus any article having a smallest cross section approximately equal to the larger upper end of the funnel can be crushed.

A very large insertion opening can be provided despite small external dimensions because the insertion opening is free from protrusions and other parts.

Another suggestion according to the invention is that the funnel has a helical cutting edge spiralling upwards and outwardly, the cutting edge of which coacts scissor-like with a second cutting edge which is also helical, upwardly and outwardly spiralling, whereby the cutting edges of both helical cutters are uninterrupted.

According to another suggestion of the invention the cutting edges are curved.

In one preferred embodiment, the funnel takes the form of a conical segment of less and 180°C. The conical segment and the surrounding funnel-shaped housing each have opposing spiralling or helically running ribs or the like with opposite direction of thread. In this embodiment the rotating conical segment is rigidly connected to a plane knife which cuts scissor-like in coaction with a fixed knife. It has proved advantageous that the rigid plane knife rotates between two fixed knives whereby the rotating knife is rigidly connected to the bearing shaft of the conical segment.

In the embodiment with conical segment and helical oppositely threaded ribs, the cutting arrangement can be of particularly simple construction. The cutting edges of the knives need not be helical but can instead be of flat or plane construction. Furthermore, the optimal operation of the cutting knives is realized. The coacting helical ribs are located on the outside of the conical segment and on the inside of the funnel shaped housing to act upon the inserted object which is to be crushed and press it forcibly in the direction of the cutting knives. When, for example, a tin can is thrown in, it is first squeezed together by the above-mentioned ribs and then pushed towards the cutting knives which can then cut it without difficulty and with optimal efficiency. The described helical ribs on the outer side of the conical segment and on the inside of the funnel shaped housing serve also to compress the inserted rubbish. If the aforementioned ribs are sharpened and their distance from each other suitably arranged, then these ribs can also perform a cutting function.

BRIEF DESCRIPTION OF THE DRAWINGS

The characteristics and advantages of the invention are described with the aid of the drawings in which:

FIG. 1 is a sectional view through the length of a first embodiment of the crushing machine. FIG. 1a is a sectional view of the lower part of the machine shown in FIG. 1, with an additional compression element. FIG. 2 is a side view of the inner funnel. FIG. 3 is a view of the funnel in the direction of the arrow III in FIG. 1 and in FIG. 2. FIG. 4 is a side view of the housing of the first embodiment. FIG. 5 is a view of the housing according to the arrow V in FIG. 4. FIG. 6 is a perspective view of the funnel shaped housing with straight line cutting edges. FIG. 7 is a perspective partial view of the housing as in FIG. 6 with a curved cutting edge. FIG. 8 is a perspective view of a cutting blade arrangement having two fixed cutting edges between which a rotating knife is moved. FIG. 9 is a section through a further embodiment. FIG. 10 is a vertical section through another embodiment. FIG. 11 is a view according to the arrow XI in FIG. 10. FIG. 12 is a view of the central funnel shaped area of the housing with fitted inner conical segment. FIG. 13 is a perspective view of the central funnel shaped area of the housing. FIG. 14 is a plan view of the rotating knife blade. FIG. 15 is a section along XV — XV in FIG. 14. FIG. 16 is a plan view of the fixed knife 36. FIG. 17 is a section along XVII — XVII in FIG. 16. FIG. 18 is a section along XVIII — XVIII in FIG. 16. FIG. 19 is a plan view of the fixed knife 35. FIG. 20 is a section along XX — XX in FIG. 19.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1-9, the housing 1 is funnel shaped and has an opening 2 through which the rubbish, having been cut and crushed, is ejected. The housing 1 has an interchangeable cutting knife 5 with a straight cutting edge; the cutting knife 5 is adjustably fixed to the housing 1. A conical funnel segment 6 is concentrically arranged in the housing 1. The funnel segment 6 is depicted as a single part in FIGS. 2 and 3. Above the opening 2 in the housing 1 is a hole or opening 15 in the funnel segment 6 through which the crushed rubbish is ejected.
From the opening 15 a helical cutting knife 7 spirals conically upwards along an edge of funnel segment 6. The funnel is stationary and in continuation forms the filling tube. On the filling tube is a rocking arm 10 which carries the driving motor 9. The motor by means of the V belt 16 rotates the worm wheel 8 which engages the oblique toothed rim 3; the toothed rim 3 is on the housing 1 so that the housing is rotated. The housing 1 and the toothed rim 3 are carried by ball-bearings 4 on the collar 17a of the funnel 6.

The housing 1 shown in FIG. 1a has an extended helical blade 17 fixed to it which rotates together with the housing 1. The extended helical blade 17 is springy in the direction of the axis and can be compressed in the direction of the housing 1. It extends into the partly illustrated rubber container 19 and, as it rotates, compresses the rubber. As the height of the rubber in the container increases, the helical blade 17 is pressed together until the blade makes contact 22. In this position, the blade switches off the driving motor. The rubber container 19 now has maximum content and must be replaced with an empty container.

The machine is so arranged that when a predetermined torque is exceeded, the direction of rotation is reversed for a certain time. This is an overload safety measure for avoiding damage to the machine when pieces are being crushed which exceed the capacity of the crushing machine. The knife 5 acts as a step upon which the rubber to be crushed is carried when the housing 1 is rotated. The rubber is then cut between the straight cutting edge 12 of the knife 5 and the cutting edge 13 of the helical cutting knife 7, due to the curvature of the cutting edge 13 at the cutting point. Thus, the largest possible cutting power on the smallest area of the cutting knife is transferred to the rubber content, the result being an extremely efficient crushing machine.

FIG. 6 shows a perspective view of the housing 1 and the knife 5 with the funnel 6 removed. FIG. 7 is a partial perspective view of the housing 1 showing the knife 5, whereby the knife 5 is no longer straight as in FIG. 6 but is helically curved. In this embodiment the cutting knife edge of the funnel preferably is straight (not illustrated).

FIG. 8 shows a blade arrangement having lower fixed knife 11 and an upper fixed knife 14. A knife 22 operates between the two knives 11 and 14, its upper cutting edge coating with the lower cutting edge of the knife 14 and its lower cutting edge coating with the upper cutting edge of the knife 11. The distance between the cutting edges of the knives 11 and 14 corresponds to the thickness of the funnel. The thickness of the knife increases from the center outwardly. It is unimportant for the operation of this cutting arrangement whether the knives 11 and 14 are stationary and the knife 22 is driven or whether, inversely, the knives 11 and 14 are driven and the knife 22 is stationary. In both cases the construction according to FIG. 8 has the important advantage that the knives 11 and 14 form a support for the content which is to be cut so that this content cannot become jammed obliquely between the cutting edges. The result is that the force on the different cutting edges is always in a forward direction of the content, that is at right angles to the connecting plane between the cutting edges of the knives 11 and 14. Because of this definite and most suitable direction of load, a much longer life expectancy is the result compared to embodiments having a single stationary cutting edge and a second cutting edge moving along it.

In FIG. 9 an embodiment is shown where the housing is a cylindrical body in which a conical, upwardly extending knife 5 is provided which is helically formed from the center and which includes a cutting edge 12. The cutting edge of the corresponding knife 7 coacts with the cutting edge 12 and can be, like the cutting edge 12, either curved or straight.

The knife 5 has an ejection opening 21 which corresponds to the ejection opening 21 of the embodiment illustrated in FIG. 7. In all embodiments the insertion opening 20 corresponds in size, form and dimension to the feed orifice of the crushing machine.

Referring now to FIGS. 10 to 20, a second embodiment of the invention includes central conical funnel segment 25, the angle 'alpha' of which is less than 180°, having an upper circular rim 26 with external teeth 3 said rim defining an upper opening in said conical funnel segment 25. At the lower end of the conical funnel segment 25 there is a flange 28 (FIG. 12) which is joined by means of a toothed or ribbed profile to the shaft 29. A sleeve 30 is also joined by means of tooth profile to the shaft 29. The lower end of the shaft 29 is of lesser diameter which is rotatably mounted through a flange 31. A nut 34 is screwed to the end of the shaft 29 for securing the flange 31 and compression wings 32 to shaft 29. Sleeve 30 is joined to the rotary knife 33 for example by means of adhesion. The flat rotary knife 12 rotates between the upper fixed knife 35 and the lower fixed knife 36. The flange 28, the sleeve 30 and the flange 31 are carried in radial bearings 38 and axial bearings 39 and 40 on the stationary housing parts, that is on the housing parts 8 which carry the stationary knives 36 and 35. The stationary knives 35 and 36 each form a hub at the center. See FIGS. 14 to 20.

The conical funnel segment 25 has a helical upwardly extending rib 41 which protrudes in the direction of the stationary funnel shaped housing 42 and an inwardly protruding rib 41a arranged on the downwardly convergent, conical interior wall of conical funnel segment 25. As shown, inwardly protruding rib 41a is of the same helical direction or hand as rib 41 and is located axially above rib 41. The housing 42 also has a helical upwardly extending rib 43 which protrudes towards the center of the funnel; the rib 41 and the rib 43 have helically opposite directions (as left hand and right hand threads). Ribs 41, 41a and 42 are continuous from the upper opening of conical funnel segment 25 to the lower opening. See FIGS. 11, 12 and 13. The result of this is that when rubber is thrown in and the conical funnel segment rotates clockwise as shown by arrow 44 in FIG. 12, the rubber is forced down and out of the center of conical funnel segment 25 by inwardly protruding rib 41a, where it is caught between the conical funnel segment 25 and the inside wall of the funnel shaped housing 42. Due to the shape and arrangement of the ribs 41 and 43, the rubber is compressed and crushed and forced downwardly into the cutting knives.

The upper rim 26 is borne by bearings 45 on the housing funnel 41. The ring of teeth 3 on the upper rim 26 coacts with a drive gear 46. The drive gear 46 is fixed to a shaft 47 which is carried at each end by bearings in the housing and which has at its lower end a worm and worm wheel drive 48 and 49, powered by the motor 50. The upper rim 26 of the conical segment 25...
is capped by a cover 51 which carries a cylindrical insertion tube. The housing 53, which carries the bearing 54 for the shaft 47, is formed together with the cover 51. The shaft 47 passes through an opening 55 in the housing 42 which is visible in FIG. 13. Below the opening 55 is a rigidly affixed flange 56 to which the motor bearing flange 57 is joined. The cover 51 is rigidly screwed to the housing 42; the lower end of the funnel shaped housing 42 is screwed to a flange 58 which, in turn, carries the stationary knives 35 and 36. A further flange 59 which surrounds the compression wings 32 is also screwed to the flange 58.

The parts which are to be shredded and crushed are placed in the tubular opening 52 and carried from there into the effective area. This effective area is formed on the one side by the inside wall of the housing cone 42 and other side by the outside wall of the conical segment 25. The rubbish which is to be crushed is drawn into the effective area and by means of the helical ribs is pushed in the direction of the cutting arrangement. The ribs can also have cutting edges which would then also cut the rubbish. The taking hold and forcibly drawing in of the rubbish is caused by the helical ribs provided on the conical housing on the one side and the conical segment on the other side, these ribs being comparable to screw threads. The helical rib 43 in the housing cone 42 has a downwardly sloping spiral path. The radius of the spiral is reduced towards the lower end. The conical segment 25, the angle 'alpha' of which is less than 180°, carries the corresponding helical rib on its outer side facing towards the housing cone. This helical rib is also in the form of a spiral, the radius of which decreases towards the lower end. When the helical rib on the conical segment is likened to a right hand thread, then the part of the helical rib on the housing cone 42 can be likened to a left hand thread. Due to the opposing rotation of the helical ribs 43 and 41, the rubbish is drawn in and forced downwardly between the ribs which spiral downwardly and radially decrease in diameter, crushing and breaking the contents. The pressure of the pincer-like grip of the helical ribs increases progressively so that a part once gripped cannot spring out again. This is especially important for springy elastic junk such as containers and other forms of thermal plastic material, etc.

The first stationary knife 35 is arranged at the lower end of the rib 43 of the housing. The cutting edge 35a is so formed and arranged as shown in FIG. 19 so that the crushed or broken parts are directed towards the center point of the cone. Below the stationary knife 35 is a rotating knife 33 as shown in FIGS. 14 and 15 which cuts off any part of rubbish which projects below the stationary knife 35. The cutting edges 33a are directed towards the center point of the cone so that cutting occurs near to the center point. By cutting near to the center point of the cone, maximum leverage can be applied via the toothed ring at the rim. The disc-shaped stationary knife 35 which has an opening for retaining bearing 37 mounted on the sleeve 30. A further stationary knife 36 shown in FIGS. 15 to 18 is situated below the rotating knife 33 and cuts the content into even smaller pieces. It is possible to provide more stationary knives and more rotating knife blades. The parts which are cut off between the stationary knife 35 and the rotating blade 33 are carried by the rotating blade which, in conjunction with the second stationary knife 36, further cuts the parts until they are of a size less than the size of the opening in the second knife 36, through which the parts can then be pushed.

The stationary knives serve not only as cutting blades but also as sieves. The following relationship exists between the slope of the helical ribs, the width of the knife blades and the number of blades on the knife:

The product of the stationary width of knife blade times the number of blades is approximately equal to the slope per revolution of the helical rib. Adhering to this relationship ensures that the rubbish contents compelled downwardly by the ribs 42 and 41 do not overload and block the knives but upon reaching the stationary knife 35 can be steadily chopped off by the blades of the rotating knife.

The apparatus, according to the invention, makes it possible for the largest parts of junk to be crushed using the minimum of parts in a machine of smallest possible dimension. This is due to the conical or funnel shaped form of the effective areas, these being free from protrusions and other parts, so that the dimension of the rubbish which is to be shredded can be approximately equal to the upper diameter of the cone or funnel. Furthermore, the rate at which the rubbish is drawn in by the effective areas can be exactly predetermined to suit the cutting rate of the knife arrangement, so that a deep predefined cutting can take place without the cutting being unnecessarily multiplied. Finally, the design and shape of the cutting element is such that the cutting occurs near to the center point of the cone so that the torque applied at the toothed rim can be most effectively utilized.

The described and illustrated construction ensures that there are no so-called "dead corners" in which rubbish can remain. All effective parts move relative to each other, such that the machine cleans itself. The conical segment 25 moves relative to the filling tube 52, relative to the housing cone 42 and relative to the first stationary knife 35. Furthermore, the rotating knife 33 moves relative to the first stationary knife 35, and to the second stationary knife 36.

The stationary knife 35 is secured by screws 60 to the lower flange 61 of the conical housing. The cutting edge 35a does not extend radially from the periphery but instead trails behind towards the center. The stationary knife 35 is ground exactly on both sides and has at its center a hub for the collar or sleeve 30.

The stationary sieving knife 36 is formed as illustrated in FIGS. 16 to 18. The cutting edge 36a is likewise not radically disposed but slopes back at the center; that is, oblique to a radial line. The stationary sieving knife is also of plate-like form and is ground exactly on its upper and lower surfaces. Between the ground edges are openings 62 for the cut material. The size of the openings determines the size of the crushed or chopped rubbish.

The openings 62 are oblique and are defined by the two neighboring oblique ribs 63, the outer rim 64 and the hub 65. The ribs 63 are arranged in the manner of propeller arms.

The rotating knife 33 of which FIG. 14 is a plan view, has spokes 33c extending from the hub 33a to the rim 33b. The cutting edges 33c extend radially from the hub 33a to the rim 33b. This knife is also exactly ground on its upper and lower surfaces and is affixed to the sleeve 30 either by tongue and groove connection or by adhesive. The knife 33 rotates in a clockwise direction as indicated by the arrow 67.
We claim:
1. A machine for crushing large objects comprising: a housing having a downwardly convergent, conical interior wall surface, said interior wall surface comprising an inwardly protruding helical rib and defining upper and lower openings in said housing; a conical funnel segment mounted within said housing between said upper and lower openings, said conical funnel segment having a downwardly convergent, conical exterior wall surface, said exterior wall surface comprising an outwardly protruding helical rib of opposite hand relative to said inwardly protruding helical rib; and means for causing relative rotation between said housing and said conical funnel segment, whereby objects placed in said conical funnel segment through said upper opening are caught between said conical funnel segment and said housing, crushed by said helical ribs and forced toward said lower opening.

2. The machine according to claim 1, wherein said conical funnel segment is less then 180° of a complete conical funnel.

3. The machine according to claim 1, wherein said means for causing relative motion comprises a toothed rim mounted on an upper portion of said conical funnel segment and a gear and motor for driving said rim to rotate said conical funnel segment within said housing.

4. The machine according to claim 1, wherein said helical ribs include cutting edges for cutting said objects as well as crushing them.

5. The machine according to claim 3, further including bearing means for supporting said conical funnel segment for rotation within said housing.

6. The machine according to claim 1, further comprising a cutter means operatively connected to said means for causing relative rotation, for cutting said objects as they are forced through said lower opening.

7. The machine according to claim 3, further comprising a cutter means connected for rotation with said conical funnel segment, for cutting said objects as they are forced through said lower opening.

8. A machine for cutting and breaking large objects comprising: a housing having a downwardly convergent, conical interior wall surface, said interior wall surface having mounted thereon an inwardly protruding knife edge and defining upper and lower openings in said housing; a conical funnel segment mounted within said housing between said upper and lower openings, said conical funnel segment having a downwardly convergent, conical wall surface and a downwardly extending knife edge along an edge of said surface for coaction with said inwardly protruding knife edge; and means for causing relative rotation between said housing and said conical funnel segment, whereby objects placed in said conical funnel segment through said upper opening are cut and broken by said knife edges and expelled from said lower opening.

9. The machine according to claim 8, wherein said downwardly extending knife edge is curved and said inwardly protruding knife edge is straight, to provide scissor-like cutting on said objects between said knife edges.

10. The machine according to claim 8, wherein said conical funnel segment is less than 180° of a complete conical funnel, said downwardly extending knife edge being along an edge of said conical funnel segment.

11. The machine according to claim 8, wherein said means for causing relative rotation comprises a toothed rim mounted on an upper portion of said housing and a gear and motor for driving said rim to rotate said housing about said conical funnel segment.

12. The machine according to claim 11, wherein said inwardly protruding knife edge defines a step for carrying said objects into cutting contact with said downwardly extending knife edge.

13. The machine according to claim 11, further including bearing means for supporting said housing for rotation about said conical funnel segment.

14. The machine according to claim 2, wherein said hollow conical funnel segment includes a downwardly convergent, conical interior wall surface comprising an inwardly protruding helical rib, whereby objects placed in said hollow conical funnel segment are forced down and out of the center of said hollow conical funnel segment by said inwardly protruding helical rib.

* * * * *